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INTELLECTUAL AND EDUCATIONAL CORRELATES OF LOW BIRTH WEIGHT.

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LOW BIRTH WEIGHT CHILDREN WERE STUDIED LONGITUDINALLY TO DETERMINE WHETHER--(1) THE RELATIVE INTELLECTUAL IMPAIRMENT OF PREMATURE CHILDREN IS STATIC OR CHANGES WITH TIME, (2) A LOW BIRTH WEIGHT CHILD NOT NOTED TO BE IN NEUROLOGICAL DISTRESS COULD HAVE A POOR PROGNOSIS, AND (3) SPECIAL EDUCATIONAL AND EMOTIONAL PROBLEMS COULD ARISE AS A CONSEQUENCE OF LOW BIRTH WEIGHT. LOW BIRTH WEIGHT AND FULL-TERM CHILDREN MATCHED BY RACE, SEASON OF BIRTH, PARITY OF MOTHER, HOSPITAL OF BIRTH, AND APPROXIMATE SOCIO-ECONOMIC STATUS WERE ADMINISTERED THE GESELL TEST AT 40 WEEKS BY A PEDIATRICIAN. THE STANFORD-BINET WAS ADMINISTERED BETWEEN 3-5 YEARS AND 6-7 YEARS. AT 8-10, TEN WISC SUBTESTS WERE ADMINISTERED. OTHER DATA WAS ALSO GATHERED FOR ANALYSIS. AS A GROUP, LOW BIRTH WEIGHT CHILDREN WERE FOUND TO BE IMPAIRED. IMPAIRMENT VARIED WITH AGE AND THE MEASUREMENT TEST. THERE WAS NO STATISTICALLY SIGNIFICANT INTERACTION BETWEEN BIRTH WEIGHT AND SOCIAL CLASS. AT 13 YEARS, LOW BIRTH WEIGHT CHILDREN HAVE LOWER IQ'S, ARE BEHIND IN GRADE PLACEMENT, AND DO NOT READ OR REASON ARITHMETICALLY AS WELL AS FULL TERM CHILDREN. THE INCIDENCE OF EDUCATIONAL AND MENTAL RETARDATION APPEARS TO DOUBLE IN LOW BIRTH WEIGHT GROUPS. (SK)

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Intellectual and Educational Correlates of Low Birth Weight

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The subject of this report is a longitudinal study of low birth weight children (an operational definition of prematurity), a project of the Johns Hopkins School of Hygiene and Public Health.

When this study originated in 1952, there was considerable uncertainty whether or not prematures were impaired. However, recent major studies, including this one, leave little doubt that prematures do show consequent mental impairment. Other issues regarding prematurity now seem important. Research questions with which this report will be concerned are:

1. Is the relative intellectual impairment of premature children static, or do differences between birth weight groups change with time?
2. Does a low birth weight child who is not noted to be in neurological distress, suffer from a poor prognosis?
3. Are there special educational or emotional problems consequent to low birth weight?

In 1952, 500 low birth weight children and 492 full-term children were selected for study. Samples were matched according to race, season of birth, parity of mother, hospital of birth, and an estimate of socioeconomic status obtained from census tract information. All infants were single born.

At four different times during the study, children were seen for psychological test procedures. The study was "blind"

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in that examiners did not know children's birth weight, previous social or psychological history

When the infants were 40 weeks of age, they were seen by a pediatrician who administered the Gesell test. Only the smallest and hardly significant differences emerged between control and premature children on this examination. However, other data were obtained during the 40-week examination including reports from the infants' hospital records, such as anoxia or muscle disorders, as well as findings from a neurological evaluation. This information was used to construct an estimate of presumed minimal brain damage. Table 1 (slide 1) shows the highly significant relationship between birth weight and the mean number of "neurologic" indicators. An F ratio of 55 based upon 2 and 816 degrees of freedom is significant. Table 1 also demonstrates that the degree of impairment is greatest for the smallest group of infants.

Nine-hundred of our children were followed at 3-5 years. Significant differences, as estimated by the Stanford-Binet, Form L, were found between birth weight groups. At age 6-7, 857 children were re-examined using the Stanford-Binet, and differences between birth weight groups remained constant. Time does not permit me to present relevant data, but it is worth noting that at age 6-7, the Stanford-Binet intelligence test is not the best discriminator between birth weight groups. A much better discrimination was made by the Bender-Gestalt test as scored by a checklist of copying errors. Also, an estimate of children's overly concrete thinking and perseveration trends seemed to distinguish low birth weight children at this age better than Stanford-Binet scores.

In short, discriminant function statistics indicate that

the relative impairment of children at age 6-7 seems to involve perceptual-motor and thinking disturbances more than I.Q. per se. This is true even when an estimate of social class based upon usual criteria such as income, education of parents, home ownership, etc., were factor analysed and resulting factor scores were controlled. However, when the neurologic scores, as shown in Table 1, were considered, the differences between birth weight groups largely disappeared. This has been a consistent finding of our study: Low birth weight children seemingly are impaired only when there is some evidence for neurologic involvement.

Most low birth weight children are "normal" and impairment is a relative term. Throughout the study, mean I.Q. differences of approximately 5 points were obtained, ant these are statistically significant when one deals with 800 to 900 cases. However, the relative impairment of low birth weight children becomes more impressive when one looks at the extremes of the distribution of cases An example of this can be seen in Table 2 (slide 2) which represents WISC scores obtained when Ss were 8 to 10 years of age. Eight-hundred and forty-seven children were seen, but only 822 were included in the analysis. I excluded the severely retarded, emotionally disturbed and physically handicapped. Of 19 such children, 16 were of low birth weight. Note that the mean I.Q. for each race varies significantly with birth weight and that the percent of those who might be diagnosed as retarded or borderline in intelligence varies with birth weight for each race. Estimates of social class were controlled through a multivariate analysis of covariance.

When seen at age 8 to 10, ten of the subtests of the WISC were administered. In addition, observations were made as regards comprehension ability, perseveration trends, instances of concrete thinking, various types of speech disturbances;

also, the Wide-Range Achievement Test was given for reading and spelling, along with the Bender-Gestalt test. All of the ten WISC subtests showed significant discrimination between prematures and controls. The object assembly and information subtests were those which produced the largest F ratios ($p < .001$). Comprehension difficulty and a tendency toward concrete reasoning also proved to be as highly significant. Perhaps surprisingly, measures of reading and spelling were not potent discriminators between birth weight groups. Results from these tests were significant at just the .05 level. Again, when an estimate of neurologic involvement was considered, the differences between prematures and controls tended to disappear.

These findings, in my opinion, would be meaningless if they did not have implications for scholastic performance. Table 3 (slide 3) represents part of the final follow-up of our children, consisting of data taken from school records when children were 12 to 13 years of age. At this time, children should have been in the 7th grade. Table 3 (slide 3) represents their actual grade placement. Eight-hundred and forty-eight children were followed who were in ordinary community schools in the Baltimore metropolitan area. Thirty-three cases were excluded because of severe mental or physical impairment. Of these 33, 29 were of low birth weight. For each race, low birth weight is associated with more than its share of children who are educationally retarded. Such educational impairment reflects global intellectual impairment. Children who are behind in grade placement tend to have significantly lower "I.Q.'s" and score significantly lower on standardized tests of achievement. Reading and Arithmetic do not show up as special forms of impairment in children of normal intelligence.

These data, and other data not shown, suggest the following conclusions:

1. As a group, low birth weight children are impaired.
2. This nature of impairment varies with the age of the child and the test used to measure it. But at all ages of childhood through to age 13, there is intellectual disability associated with low birth weight in a monotonic fashion. The lowest birth weight group seem to be the most afflicted.
3. Impairment is consequent to neurologic involvement.
4. There is no <u>statistical interaction between birth weight and social class</u>. Rich and poor premature children are impaired to the same degree.
5. I did <u>not</u> obtain evidence of an emotional disturbance in low birth weight children. Presumably, brain-damaged children should be hyperactive, impulsive, or aggressive. In our study, two groups of psychologists, as well as school teachers, failed to find personality trait differences. Although personality ratings are unreliable, they did come from three independent sources. Perhaps the minimal defect associated with low birth weight does not cause emotional disturbances of the expected variety.
6. At age 13, ex-prematures have lower I.Q.'s, are behind in their grade placement, and do not read or reason arithmetically as well as full-term children.

Although all socioeconomic groups are equally affected by low birth weight, it is important to note that the <u>incidence</u> of low birth weight has interesting epidemiological trends.

It is highest in lower-class people, particularly Negroes, and in people without adequate prenatal care. In Baltimore, approximately 19% of all Negroes (in 1961) were born with birth weights of less than 2500 grams. Such correlational data raise the question about how much of the variance regarding academic performance, so commonly noted between racial and social groups, is due to preventable constitutional factors as well as factors known to be cultural and familial.

Another implication of our study is suggested by the fact that the incidence of educational and mental retardation seems to double in low birth weight groups. There is a group of children in our schools whose I.Q. is less than 90. Although these children may be poor, they are more than culturally deprived. Some should be thought of as minimally brain-damaged in educational planning for them.

Table 1

Mean Number of Perinatal and Neurologic Abnormalities
By Race and Birth Weight

	≤ 2000 g		2000-2500 g		> 2500 g	
	Mean	No.	Mean	No.	Mean	No.
White	6.59	32	4.69	125	3.32	167
Negro	6.92	83	4.40	177	3.33	238

N = 822

F (for birth weight) = 55.72, 2 & 816 df, $p < .001$

Table 2

WISC I.Q. Scores at Age 8-10 by Race and Birth Weight

	Birth Weight (Gm)		
	<2000	2000-2500	>2500
A. White			
Total No.	32	125	167
Mean I.Q.	97	99	105
% with I.Q. of 50-79	13	10	5
B. Negro			
Total No.	83	177	238
Mean I.Q.	83	86	90
% with I.Q. of 50-79	39	35	19

N = 822

F (for birth weight) = 22.94, 2 & 816 df, $p < .001$

Table 3

Grade Placement for Children in Community Schools When Ages 12-13

	White				Negro			
	Prematures		Controls		Prematures		Controls	
Grade Placement	No.	%	No.	%	No.	%	No.	%
4th, 5th grades (or special education)	32	19.4	18	9.6	91	35.8	54	22.4
6th grade	33	20.0	41	21.8	71	28.0	75	31.1
7th grade	100	60.6	129	68.6	92	36.2	112	46.4
Total	165	100.0	188	100.0	254	100.0	241	99.9

N = 848

X^2 = 18.06, 4 df, $p < .01$ (Computed for each race and pooled)

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